

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 6	ENGINEERED SAFETY FEATURES	6-0.1
6.0	Engineered Safety Features	6-0.1
6.1	Engineered Safety Features Materials	6.1-1
6.1.1	Metallic Materials	6.1-1
6.1.1.1	Specifications for Principal Pressure-Retaining Materials.....	6.1-1
6.1.1.2	Fabrication Requirements.....	6.1-2
6.1.1.3	Specifications for Nonpressure-Retaining Materials	6.1-3
6.1.1.4	Material Compatibility with Reactor Coolant System Coolant and Engineered Safety Features Fluids	6.1-3
6.1.1.5	Integrity of Safety-Related Components.....	6.1-4
6.1.1.6	Thermal Insulation	6.1-4
6.1.1.7	Component and System Cleaning.....	6.1-4
6.1.2	Organic Materials.....	6.1-4
6.1.2.1	Protective Coatings.....	6.1-4
6.1.2.2	Other Organic Materials	6.1-10
6.1.3	Combined License Information Items	6.1-10
6.1.3.1	Procedure Review.....	6.1-10
6.1.3.2	Coating Program.....	6.1-10
6.1.4	References.....	6.1-11
6.2	Containment Systems	6.2-1
6.2.1	Containment Functional Design.....	6.2-1
6.2.1.1	Containment Structure.....	6.2-1
6.2.1.2	Containment Subcompartments.....	6.2-4
6.2.1.3	Mass and Energy Release Analyses for Postulated Pipe Ruptures	6.2-6
6.2.1.4	Mass and Energy Release Analysis for Postulated Secondary-System Pipe Rupture Inside Containment	6.2-11
6.2.1.5	Minimum Containment Pressure Analysis for Performance Capability Studies of Emergency Core Cooling System (PWR)	6.2-14
6.2.1.6	Testing and Inspection.....	6.2-16
6.2.1.7	Instrumentation Requirements.....	6.2-16
6.2.2	Passive Containment Cooling System.....	6.2-17
6.2.2.1	Safety Design Basis.....	6.2-17
6.2.2.2	System Design.....	6.2-18
6.2.2.3	Safety Evaluation.....	6.2-23
6.2.2.4	Testing and Inspection.....	6.2-24
6.2.2.5	Instrumentation Requirements.....	6.2-26
6.2.3	Containment Isolation System.....	6.2-26
6.2.3.1	Design Basis.....	6.2-27
6.2.3.2	System Description.....	6.2-30
6.2.3.3	Design Evaluation	6.2-32

TABLE OF CONTENTS (Cont.)

<u>Section</u>	<u>Title</u>	<u>Page</u>
6.2.4	6.2.3.4 Tests and Inspections..... 6.2.3.5 Instrumentation and Control Application	6.2-35 6.2-35
6.2.4	Containment Hydrogen Control System..... 6.2.4.1 Design Basis..... 6.2.4.2 System Design..... 6.2.4.3 Design Evaluation (Design Basis Accident)..... 6.2.4.4 Design Evaluation (Severe Accident)..... 6.2.4.5 Tests and Inspections..... 6.2.4.6 Combined License Information	6.2-36 6.2-36 6.2-38 6.2-41 6.2-41 6.2-41 6.2-42
6.2.5	Containment Leak Rate Test System	6.2-42
6.2.5	6.2.5.1 Design Basis..... 6.2.5.2 System Description..... 6.2.5.3 Safety Evaluation..... 6.2.5.4 Inservice Inspection/Inservice Testing.....	6.2-42 6.2-43 6.2-48 6.2-48
6.2.6	6.2.6 Combined License Information for Containment Leak Rate Testing	6.2-48
6.2.7	6.2.7 References.....	6.2-49
6.3	Passive Core Cooling System.....	6.3-1
6.3.1	6.3.1 Design Basis	6.3-1
6.3.1	6.3.1.1 Safety Design Basis..... 6.3.1.2 Power Generation Design Basis	6.3-2 6.3-5
6.3.2	6.3.2 System Design	6.3-5
6.3.2	6.3.2.1 Schematic Piping and Instrumentation Diagrams..... 6.3.2.2 Equipment and Component Descriptions	6.3-6 6.3-11
6.3.2	6.3.2.3 Applicable Codes and Classifications	6.3-25
6.3.2	6.3.2.4 Material Specifications and Compatibility	6.3-26
6.3.2	6.3.2.5 System Reliability..... 6.3.2.6 Protection Provisions..... 6.3.2.7 Provisions for Performance Testing	6.3-26 6.3-29 6.3-30
6.3.2	6.3.2.8 Manual Actions	6.3-30
6.3.3	6.3.3 Performance Evaluation	6.3-30
6.3.3	6.3.3.1 Increase in Heat Removal by the Secondary System	6.3-32
6.3.3	6.3.3.2 Decrease in Heat Removal by the Secondary System..... 6.3.3.3 Decrease in Reactor Coolant System Inventory..... 6.3.3.4 Shutdown Events.....	6.3-34 6.3-35 6.3-38
6.3.4	6.3.4 Post-72 Hour Actions.....	6.3-42
6.3.5	6.3.5 Limits on System Parameters	6.3-42
6.3.6	6.3.6 Inspection and Testing Requirements	6.3-43
6.3.6	6.3.6.1 Preoperational Inspection and Testing..... 6.3.6.2 In-Service Testing and Inspection	6.3-43 6.3-44
6.3.7	6.3.7 Instrumentation Requirements	6.3-45
6.3.7	6.3.7.1 Pressure Indication	6.3-45
6.3.7	6.3.7.2 Temperature Indication	6.3-45

TABLE OF CONTENTS (Cont.)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	6.3.7.3 Passive Residual Heat Removal Heat Exchanger Outlet Flow Indication	6.3-46
	6.3.7.4 Level Indication.....	6.3-47
	6.3.7.5 Containment Radiation Level.....	6.3-47
	6.3.7.6 Valve Position Indication and Control.....	6.3-48
	6.3.7.7 Automatic Depressurization System Actuation at 24 Hours....	6.3-49
6.3.8	Combined License Information.....	6.3-49
	6.3.8.1 Containment Cleanliness Program	6.3-49
	6.3.8.2 Verification of Water Sources for Long-Term Recirculation Cooling Following a LOCA	6.3-49
6.3.9	References.....	6.3-50
6.4	Habitability Systems.....	6.4-1
6.4.1	Safety Design Basis	6.4-1
	6.4.1.1 Main Control Room Design Basis.....	6.4-1
	6.4.1.2 Instrumentation and Control Room/DC Equipment Rooms Design Basis.....	6.4-2
6.4.2	System Description	6.4-2
	6.4.2.1 Definition of the Main Control Room Pressure Boundary	6.4-2
	6.4.2.2 General Description.....	6.4-3
	6.4.2.3 Component Description.....	6.4-4
	6.4.2.4 Leaktightness.....	6.4-6
	6.4.2.5 Interaction with Other Zones and Pressurized Equipment.....	6.4-7
	6.4.2.6 Shielding Design	6.4-7
6.4.3	System Operation.....	6.4-7
	6.4.3.1 Normal Mode	6.4-7
	6.4.3.2 Emergency Mode.....	6.4-7
6.4.4	System Safety Evaluation.....	6.4-8
6.4.5	Inservice Inspection/Inservice Testing	6.4-10
	6.4.5.1 Preoperational Inspection and Testing.....	6.4-11
	6.4.5.2 Inservice Testing	6.4-11
	6.4.5.3 Air Quality Testing.....	6.4-11
	6.4.5.4 Main Control Room Envelope Habitability.....	6.4-12
6.4.6	Instrumentation Requirements	6.4-12
6.4.7	Combined License Information.....	6.4-13
6.4.8	References.....	6.4-13
6.5	Fission Product Removal and Control Systems.....	6.5-1
6.5.1	Engineered Safety Feature (ESF) Filter Systems	6.5-1
6.5.2	Containment Spray System	6.5-1
	6.5.2.1 System Description.....	6.5-1
	6.5.2.2 Design Evaluation	6.5-3

TABLE OF CONTENTS (Cont.)

<u>Section</u>	<u>Title</u>	<u>Page</u>
6.5	6.5.3 Fission Product Control Systems	6.5-5
	6.5.3.1 Primary Containment.....	6.5-5
	6.5.3.2 Secondary Containment.....	6.5-6
6.5.4	Combined License Information.....	6.5-6
6.5.5	References.....	6.5-6
6.6	<u>Inservice Inspection of Class 2 and 3 Components</u>	<u>6.6-1</u>
6.6.1	Components Subject to Examination	6.6-1
6.6.2	Accessibility.....	6.6-1
6.6.3	Examination Techniques and Procedures	6.6-2
6.6.4	Inspection Intervals	6.6-2
6.6.5	Examination Categories and Requirements.....	6.6-3
6.6.6	Evaluation of Examination Results	6.6-3
6.6.7	System Pressure Tests	6.6-3
6.6.8	Augmented Inservice Inspection to Protect against Postulated Piping Failures	6.6-3
6.6.9	Combined License Information Items	6.6-3
	6.6.9.1 Inspection Programs	6.6-3
	6.6.9.2 Construction Activities	6.6-4

APPENDIX 6A FISSION PRODUCT DISTRIBUTION IN THE AP1000 POST-DESIGN BASIS ACCIDENT CONTAINMENT ATMOSPHERE 6A-1

6A.1	Design Basis Sequence Assumptions	6A-1
6A.1.1	Break Size and Fission Product Release Location in Containment.....	6A-2
	6A.1.1.1 Releases From Depressurization System Lines	6A-2
	6A.1.1.2 Releases From Coolant Loop Breaks.....	6A-3
	6A.1.1.3 Direct Vessel Injection Line Breaks	6A-3
	6A.1.1.4 Core Makeup Tank Balance Line Breaks	6A-3
	6A.1.1.5 Chemical and Volume Control System Line Breaks	6A-3
	6A.1.1.6 Fission Product Release Location Conclusion.....	6A-4
6A.2	Containment Natural Circulation and Mixing	6A-4
6A.3	Insights From the Passive Containment Cooling System Large Scale Test and AP1000 Stratification Studies	6A-7
6A.4	Conclusions	6A-8
6A.5	References	6A-9

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
6.1-1	Engineered Safety Features Pressure-Retaining Materials	6.1-12
6.1-2	AP1000 Coated Surfaces, Containment Shell and Surfaces Inside Containment	6.1-13
6.2.1.1-1	Summary of Calculated Pressures and Temperatures.....	6.2-51
6.2.1.1-2	Initial Conditions.....	6.2-51
6.2.1.1-3	Results of Postulated Accidents	6.2-52
6.2.1.1-4	Deleted	
6.2.1.1-5	Deleted	
6.2.1.1-6	Deleted	
6.2.1.1-7	Deleted	
6.2.1.1-8	Physical Properties of Passive Heat Sinks	6.2-54
6.2.1.2-1	Listing of Lines Not LBB Qualified and the Calculated Maximum Differential Pressures (Sheets 1 – 3)	6.2-55
6.2.1.3-1	Short-Term Mass and Energy Inputs.....	6.2-58
6.2.1.3-2	Short-Term 3-Inch Cold-Leg Break Mass and Energy Releases	6.2-59
6.2.1.3-3	Short-Term 3-Inch Hot-Leg Break Mass and Energy Releases	6.2-60
6.2.1.3-4	Main Steam Line Break Mass and Energy (1 Ft ² Break).....	6.2-61
6.2.1.3-5	4" SG Blowdown Line Mass and Energy Releases	6.2-62
6.2.1.3-6	Pressurizer Spray Line Break Releases	6.2-63
6.2.1.3-7	Short Term 3-Inch Single-Ended Cold-Leg Break Mass and Energy Releases	6.2-64
6.2.1.3-8	Basis for Long-Term Analysis.....	6.2-65
6.2.1.3-9	Long-Term DECL Break Mass and Energy Releases (Sheets 1 – 10).....	6.2-66
6.2.1.3-10	Blowdown DEHL Break Mass and Energy Releases (Sheets 1 – 5)	6.2-76
6.2.1.4-1	Not Used	
6.2.1.4-2	Mass and Enthalpy Release Data for the Case of Main Steam Line Full Double Ended Rupture from 30% Power Level with Faulted Loop Main Steam Line Isolation Valve Failure that Produces Highest Containment Pressure (Sheets 1 – 5)	6.2-82
6.2.1.4-3	Not Used	
6.2.1.4-4	Plant Data Used for Mass and Energy Releases Determination	6.2-88
6.2.1.5-1	Minimum Containment Pressure Mass and Energy Releases (Sheets 1 – 3)	6.2-89
6.2.2-1	Passive Containment Cooling System Performance Parameters.....	6.2-92
6.2.2-2	Component Data Passive Containment Cooling System (Nominal).....	6.2-93
6.2.2-3	Failure Mode and Effects Analysis - Passive Containment Cooling System Active Components	6.2-94
6.2.3-1	Containment Mechanical Penetrations and Isolation Valves (Sheets 1 – 4).....	6.2-95
6.2.4-1	Component Data - Hydrogen Sensors (Nominal).....	6.2-103
6.2.4-2	Component Data - Hydrogen Recombiner (Nominal).....	6.2-104
6.2.4-3	Component Data - Hydrogen Igniter (Nominal).....	6.2-105
6.2.4-4	Not Used	

LIST OF TABLES (Cont.)

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
6.2.4-5	Not Used	
6.2.4-6	Igniter Location (Sheets 1 – 3)	6.2-107
6.2.4-7	Subcompartment/Area Igniter Coverage	6.2-110
6.3-1	Passive Core Cooling System - Remote Actuation Valves	6.3-51
6.3-2	Component Data - Passive Core Cooling System (Sheets 1 – 2).....	6.3-52
6.3-3	Failure Mode and Effects Analysis - Passive Core Cooling System Active Components (Sheets 1 – 4)	6.3-54
6.4-1	Onsite Chemicals.....	6.4-14
6.4-2	Main Control Room Habitability Indications and Alarms.....	6.4-15
6.4-3	Loss of AC Power Heat Load Limits	6.4-16
6.5.3-1	Primary Containment Operation Following a Design Basis Accident.....	6.5-7

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
6.2.1.1-1	AP1000 Containment Response for Full DER MSLB – 30% Power.....	6.2-111
6.2.1.1-2	AP1000 Containment Response for Full DER MSLB – 101% Power	6.2-112
6.2.1.1-3	Not Used	
6.2.1.1-4	Not Used	
6.2.1.1-5	AP1000 Containment Pressure Response for DECLG LOCA.....	6.2-114
6.2.1.1-6	AP1000 Containment Temperature Response to DECLG LOCA.....	6.2-115
6.2.1.1-7	AP1000 Containment Pressure Response for DECLG LOCA – 3 Days.....	6.2-116
6.2.1.1-8	AP1000 Containment Temperature Response for DECLG LOCA – 3 Days	6.2-117
6.2.1.1-9	AP1000 Containment Pressure Response – DEHLG LOCA	6.2-118
6.2.1.1-10	AP1000 Containment Response for DEHLG LOCA	6.2-119
6.2.1.1-11	AP1000 External Pressure Analysis Containment Pressure vs. Time	6.2-120
6.2.1.3-1	AP1000 DECLG Integrated Break Flow.....	6.2-121
6.2.1.3-2	AP1000 DECLG LOCA Integrated Energy Released.....	6.2-122
6.2.1.3-3	AP1000 DEHLG Integrated Break Flow.....	6.2-123
6.2.1.3-4	AP1000 DEHLG LOCA Integrated Energy Released.....	6.2-124
6.2.1.5-1	AP1000 Minimum Containment Pressure for DECLG LOCA	6.2-125
6.2.2-1	Passive Containment Cooling System Piping and Instrumentation Diagram (Sheets 1 – 2).....	6.2-127
6.2.2-2	Simplified Sketch of Passive Containment Cooling System	6.2-131
6.2.4-1	Not Used	
6.2.4-2	Not Used	
6.2.4-3	Not Used	
6.2.4-4	Not Used	
6.2.4-5	Hydrogen Igniter Locations – Section View	6.2-133
6.2.4-6	Hydrogen Igniter Locations Plan View Elevation 82'-6"	6.2-134
6.2.4-7	Hydrogen Igniter Locations – Section View	6.2-135
6.2.4-8	Hydrogen Igniter Locations Plan View Elevation 96'-6"	6.2-136
6.2.4-9	Hydrogen Igniter Locations Plan View Elevation 118'-6"	6.2-137
6.2.4-10	Hydrogen Igniter Locations Plan View Elevation 135'-3"	6.2-138
6.2.4-11	Hydrogen Igniter Locations Plan View Elevation 162'-0"	6.2-139
6.2.4-12	Hydrogen Igniter Locations Plan View Elevation 210'-0"	6.2-140
6.2.4-13	Hydrogen Igniter Locations Section A-A	6.2-141
6.2.5-1	Containment Leak Rate Test System Piping and Instrumentation Diagram	6.2-143
6.3-1	Passive Core Cooling System Piping and Instrumentation Diagram (Sheet 1).....	6.3-59
6.3-2	Passive Core Cooling System Piping and Instrumentation Diagram (Sheet 2).....	6.3-61
6.3-3	Passive Safety Injection.....	6.3-63
6.3-4	Passive Decay Heat Removal	6.3-64
6.3-5	Passive Heat Removal Heat Exchanger.....	6.3-65
6.3-6	IRWST Screen Plan Location	6.3-66
6.3-7	IRWST Screen Section Location.....	6.3-67
6.3-8	Containment Recirculation Screen Location Plan	6.3-68
6.3-9	Containment Recirculation Screen Location Elevation	6.3-69

LIST OF FIGURES (Cont.)

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
6.4-1	Main Control Room Envelope.....	6.4-17
6.4-2	Main Control Room Habitability System Piping and Instrumentation Diagram (Sheets 1 – 2).....	6.4-19
6.5-1	Containment Spray Coverage at Operating Deck	6.5-8
6A-1	RCS Release Locations	6A-10
6A-2	Containment Natural Circulation	6A-11